Protecting the Edwards Aquifer: A Scientific Consensus

Introduction

The Edwards Aquifer is an irreplaceable natural resource. The Aquifer provides water for drinking, business, agriculture, and recreation; for essential streamflows for river and estuary ecosystems downstream of the major spring outflows (at Comal, San Marcos, Barton, Hueco, Salado, and elsewhere); and for necessary habitat for over fifty species of plants and animals found in Central Texas and nowhere else in the world.

There is broad public support to protect and manage the Edwards Aquifer so that it will continue to provide high-quality water for future generations of Texans. Protecting the Aquifer requires public and private action based on sound science. The following statements and recommendations reflect the common views of the undersigned scientists, engineers, and planners. These individuals are familiar with the best scientific information about the Edwards Aquifer.

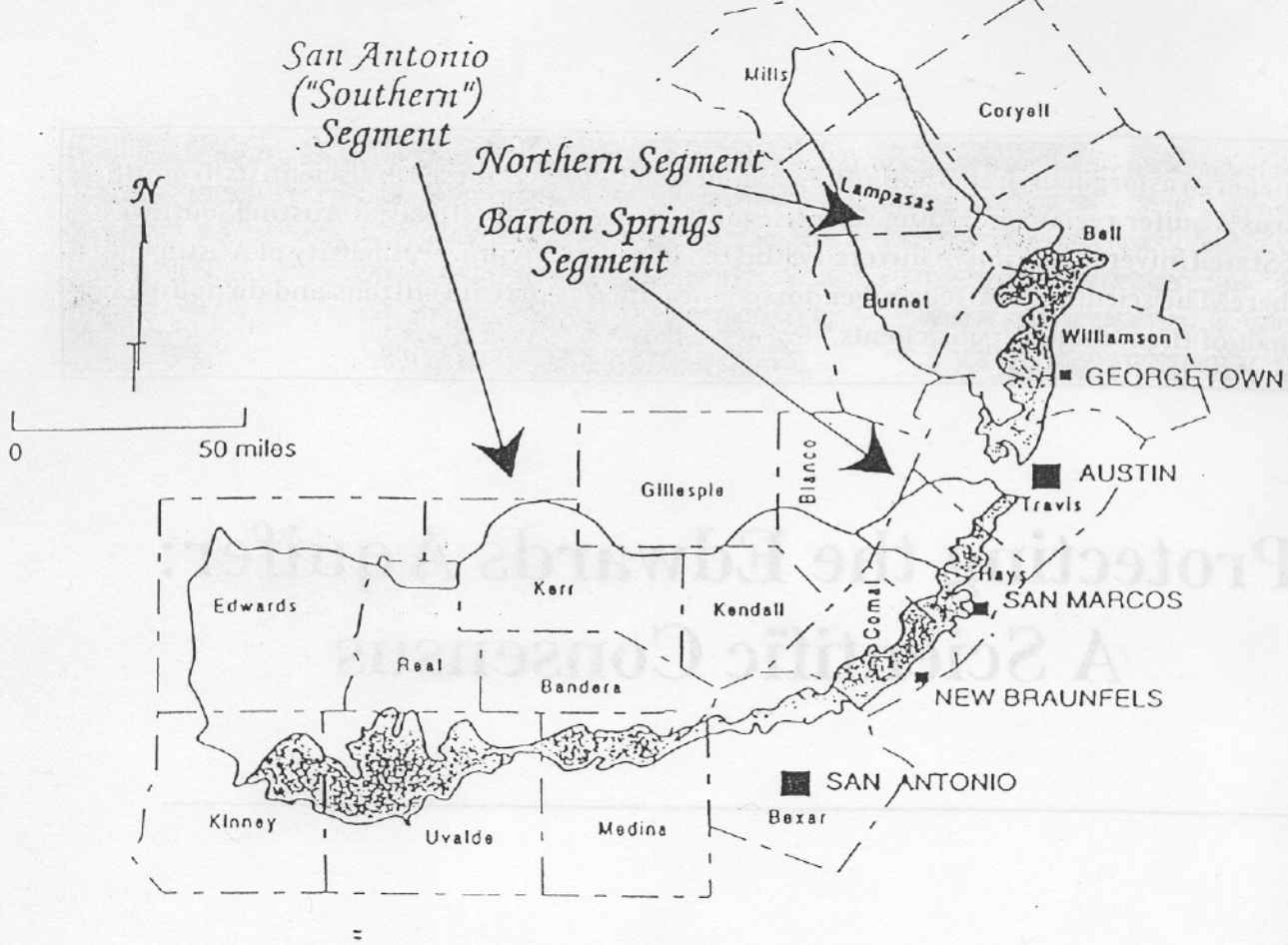


Figure 1. Contributing and Recharge Zones of the three segments of the Edwards (Balcones Fault Zone) Aquifer. *The Contributing Zones are the unshaded areas to the north and west, and the Recharge Zones are the shaded areas to the south and east.*

Factual Background

The Edwards Aquifer, (shown in Figures 1 and 2), currently provides a high-quality source of water whose quantity is limited by rainfall, recharge capacity, storage capacity, and withdrawals.

The Edwards Aquifer is a karst limestone aquifer, characterized by conduits through which water travels rapidly and a thin to absent soil cover, as shown in Figure 3. These characteristics allow minimal filtration or adsorption of contaminants. Thus the aquifer is particularly vulnerable to contamination from human activities occurring in its watershed.

While the overall water quality in the Aquifer remains high, scientists have documented occurrences of water quality degradation at wells and springs.

- Contaminant levels associated with human activity have been detected at levels exceeding natural background in wells, springs, and sediments in creeks that recharge the Aquifer. These contaminants include pesticides, metals, and petroleum hydrocarbons (footnote 1). At times, concentrations have been at levels that are harmful to aquatic life and human health.
- Development has increased contaminant and sediment loads in the surface waters that recharge the Aquifer (footnote 2).

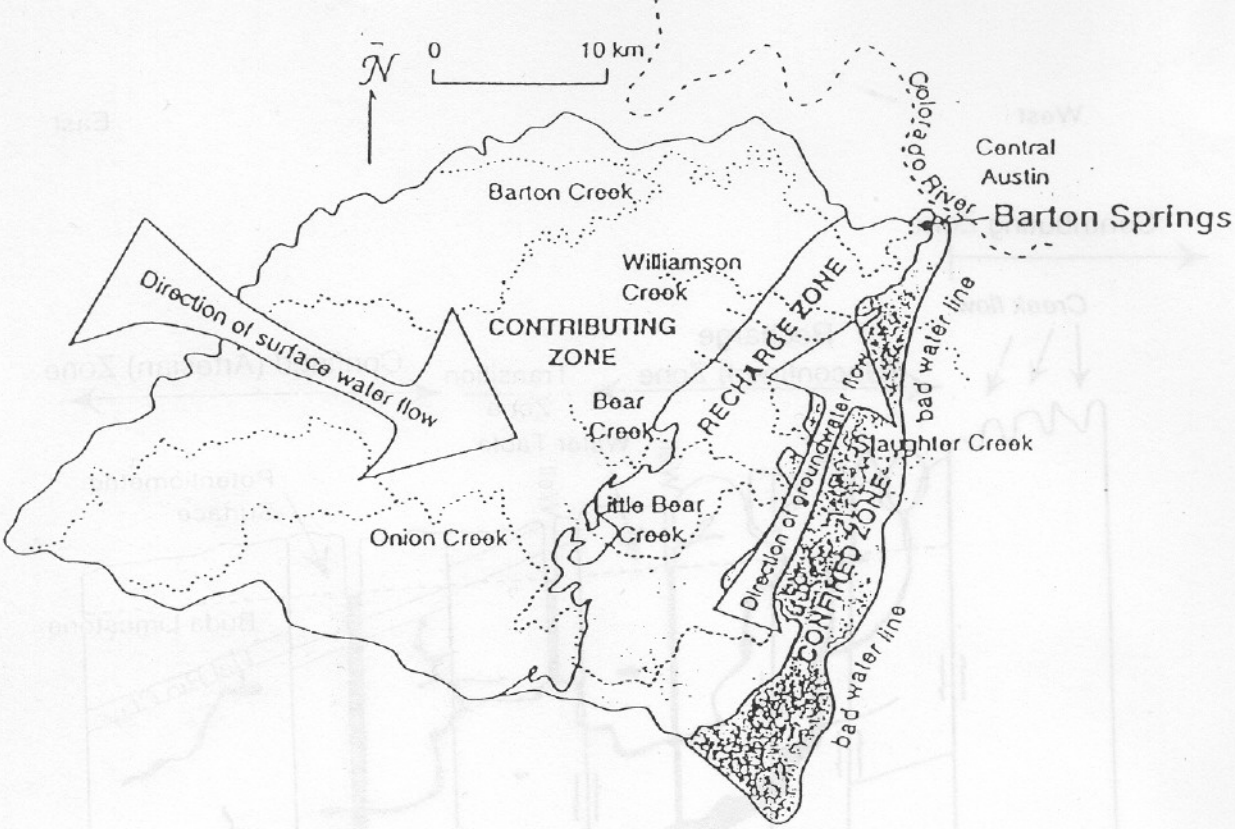


Figure 2. Runoff from precipitation falling on the Contributing Zone flows eastward in creeks until it crosses onto the porous Edwards Limestone (Recharge Zone), where it infiltrates into the aquifer through fissures in creekbeds. *Precipitation falling on the Recharge Zone enters the aquifer both as direct infiltration and through fissured creekbeds. Once recharge from the surface enters the aquifer, it flows north as groundwater through conduits dissolved along faults and fractures to discharge at Barton Springs.*

Key Points of Consensus

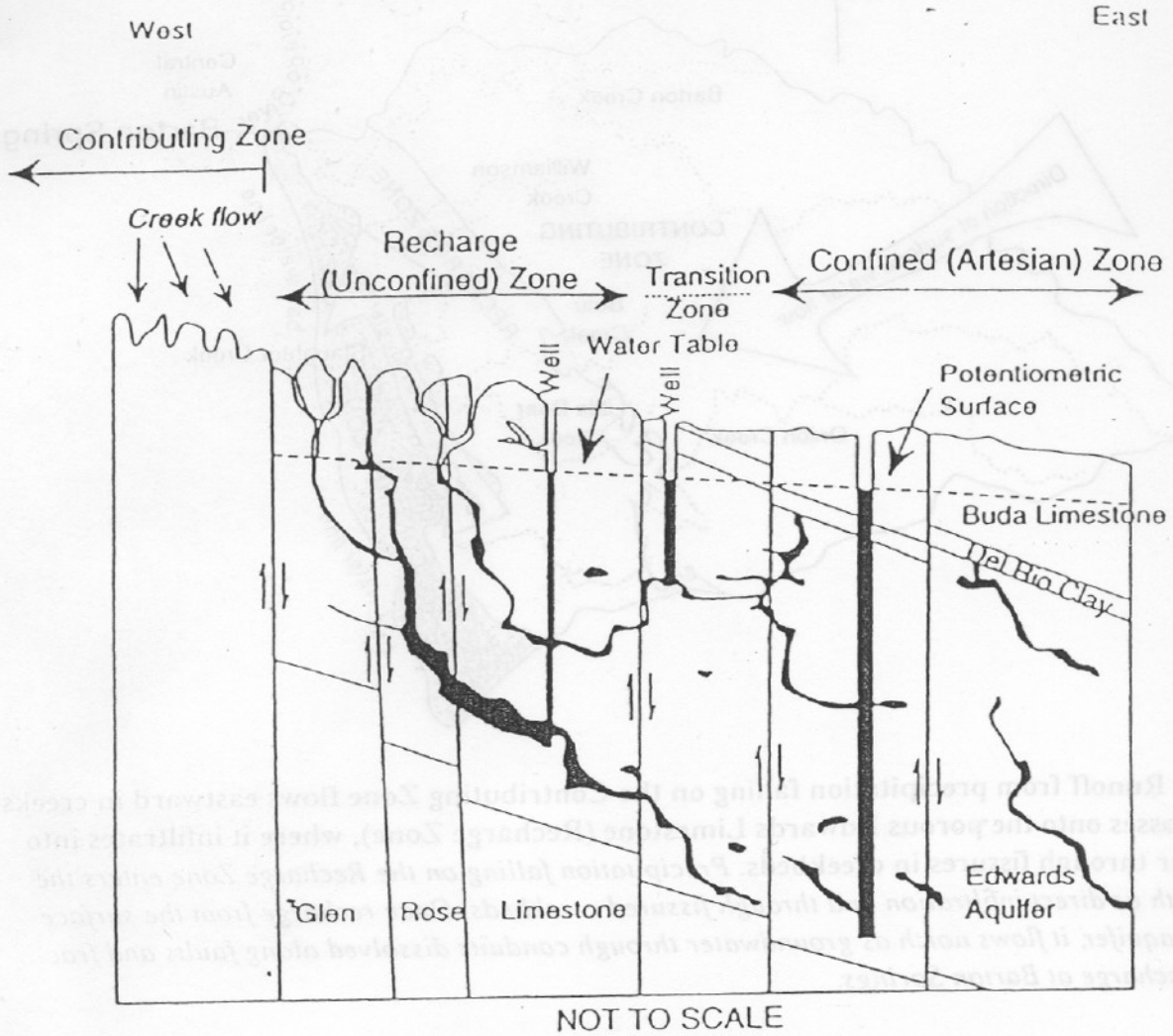
1) Development in the Edwards Aquifer recharge zone and contributing zone is projected to increase rapidly in the immediate future (footnote 3). We anticipate this development will lead to increased contamination of and withdrawals from the Aquifer.

2) Existing rules, regulations, and practices have not been and are not adequate to prevent contamination of the Edwards Aquifer, or to prevent withdrawals that threaten the flow at Barton Springs.

3) It is neither technically nor economically feasible to prevent contamination of the Edwards Aquifer without limiting the amount of impervious cover in its recharge zone and contributing zone (footnote 4).

4) Engineered controls, known also as BMPs, can decrease but not eliminate contamination of the Edwards Aquifer. Even if perfectly maintained, BMPs are not a substitute for limits on impervious cover. While current BMP designs can be improved, no technology will ever be perfect, and improper maintenance degrades the performance of even the best engineered controls.

5) An important strategy to prevent contamination of the Edwards Aquifer is to minimize the use, transport, and storage of chemicals and contaminants in



Schematic cross-section of the Barton Springs portion of the Edwards Aquifer. *Water flows eastward, via creeks, across the surface of the Contributing Zone until it crosses onto the extremely permeable Edwards Limestone (Recharge Zone). It then flows northward ("into" this page) to Barton Springs via conduits dissolved along faults and fractures. Adapted from Slade et al. (1986).*

Key Points of Consensus, continued

its watershed. Measures are needed to protect the Aquifer from contamination by roadway runoff, pipelines, chemical storage and transport, pesticides, and herbicides.

6) Pumping from the Edwards Aquifer must be limited to prevent depletion of the Aquifer, cessation of spring flows, local intrusion of "bad water", and extinction of native species.

7) The quality of surface water in all of the contributing and recharge zones affects the quality of water in the Edward Aquifer.

Recommendations

Governments, private corporations, and citizens should:

Act promptly to direct urban development away from the Edwards Aquifer's recharge and contributing zones through control of infrastructure investment and the use of zoning and other appropriate planning techniques;

Institute safeguards that will reduce contamination and the risk of catastrophic events from ongoing activities in the Edwards Aquifer's watershed, and minimize contamination from future development;

Develop and enforce rules and regulations across both the recharge and contributing zones to strengthen protections of water quality in the Edwards Aquifer;

Restrict impervious cover in the recharge and contributing zones to levels that will sustain existing water quality;

Support measures that reduce consumption of water from the Edwards Aquifer and that preserve recharge to the Aquifer; and

Promote public education, the acquisition of preserves and conservation easements, the protection of recharge features, and other strategies to complement the regulations designed to prevent contamination and overpumping of the Edwards Aquifer.

Footnotes

1. Contamination has been particularly well-documented in the Barton Springs segment of the Edwards Aquifer. Some of the findings there include:

- Water samples from one outlet of Barton Springs (Sunken Garden) has shown high levels of lead. The total concentration of lead was 0.024 mg/l in a sample from 1994 (Hauwert and Vickers, 1994). That concentration exceeds the EPA maximum contaminant level for total lead in drinking water, which is 0.015 mg/l. Arsenic is a highly toxic metal that is used in the manufacture of agricultural pesticides and other products, and that is found in roadway runoff. It has been found in Aquifer wells at levels in excess of 0.05 mg/l (Hauwert and Vickers, 1994), which is the EPA maximum contamination level for arsenic in drinking water.
- Polycyclic aromatic hydrocarbons, of PAHs, are toxic and carcinogenic compounds formed by the breakdown of motor oil and other manmade products. Sediment collected from Barton Springs Pool on April 20, 1995, contained PAHs at concentrations up to 6.5 times over that known to be toxic to Hyallela azteca, an invertebrate that is common in the Aquifer's springs (City of Austin, 1994, 1997; Ingersoll et al., 1996).
- Total nitrogen concentrations measured in wells in the more urbanized areas of the Barton Springs watershed are typically two to six times higher than in rural areas (Slade, 1992).
- Elevated levels of total phosphorus and orthophosphorus have been detected in wells and springs (Slade, 1992; Hauwert and Vickers, 1994; City of Austin, 1997).

Footnotes, continued

2. Water quality in each of the six streams that recharge the Barton Springs segment of the Edwards Aquifer has been studied (Veenhuis and Slade, 1990). The water quality during baseflow conditions is similar for many of the sites that were sampled, but the water of stormflow is much degraded for the sites in developed basins. For example, the highest values for nitrogen, suspended solids, total organic carbon, phosphorus, and fecal bacteria were found in Williamson Creek and two sites in the lower reaches of Barton Creek--sites that receive runoff from the most developed basins. The stormflow concentrations of contaminants in the lower reaches of Barton Creek exceed the values found in the upper reaches of Barton Creek by several hundred percent or more. Most of the development in the Barton Creek drainage basin is limited to the lower reaches. Water-quality data for the other streams reveal similar patterns: water quality degrades with increased development.

3. By one estimate, the population of the Edwards Aquifer region will grow approximately 46% in the 15 years between 1995 and 2010. This figure is based on the number of people using public water supplies that take their water from the Edwards Aquifer south of the Colorado River. In 1995, that number was estimated at 1,625,384, while in 2010 it is projected to be 2,374,549 (Barton Springs/Edward Aquifer Conservation District, 1997; Texas Water Development Board, 1994, 1996).

4. Impervious cover is defined as the total area of roads, parking lots, sidewalks, rooftops, and other impermeable surfaces on the urban landscape. In effect, it can be considered as the percentage of area that is not natural or "green" (Schueler, 1994). It has been demonstrated that a relatively low percentage of impervious cover (10% to 15%) can induce adverse and irreversible changes in the quality of streams (Veenhuis and Slade, 1990). The effects are related to changes in the hydrology, water quality, habitat structure, and biodiversity of the aquatic system (Schueler 1994, 1995, 1996). Further, monitoring studies indicate that urban contaminant loads are directly related to the amount of impervious cover in the watershed. In most models, impervious cover is the key predictive variable used to estimate contaminant loads. Once the percentage of impervious cover exceeds about 25%, many streams become "non-supporting" and are characterized by fair to poor water quality, highly unstable channels, and poor biodiversity. Because streams flowing across the recharge zone and contributing zone resupply the Edwards Aquifer as the water infiltrates, maintenance of high water quality in these streams is a major concern.

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